
PNEUMOTHORAX FROM GAS-PRODUCING BACTERIA.

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The presence of gas in the pleura without perforation is an old question with medical authorities. Lænnec believed that a secretion of gas could take place in a healthy pleura, and although this view was considered untenable for a long period, yet subsequent writers have regarded it as probable that an evolution of gas may occur in certain pathological conditions. Senator† states his views on this subject very clearly. He considers that the gases held in solution by fluids in the pleural cavity may escape in accordance with physical laws, provided that the pressure is diminished by retraction of the lung, but that such an amount can only be inconsiderable. Further, however, he considers that purulent fluids undergoing decomposition in the pleura can evolve gases. This argument is supported by the facts that subcutaneous emphysema may occur in a limb in the absence of any external wound, and also by the presence of gas occasionally noted in phlegmons.

It is, however, only within the last four years that any facts have been brought forward placing such views on a scientific basis. Welch's‡ discovery of the bacillus capsulatus aërogenes, followed by numerous pathological observations, remove all doubt as to the production of gas in living tissues by bacteria. In one of Welch's cases pneumo-peritonitis was present without perforation. A large number of his cases involved the abdominal organs (12 out of 23.)

The following case, although primarily one of subdiaphragmatic abscess rupturing into the pleura, is a good example of a pneumothorax due to gas production by the bacillus coli.

J. W., æt 46, a deaf-mute, was admitted December 26th, 1898, to the surgical side of the Montreal General Hospital for sudden severe pain in the abdomen, which his physician regarded as appendicitis. Dr. Hutchison, under whose care he was placed, found no evidence of abdominal disease but some days later discovered signs of fluid at the right base, and on aspirating some clear serum was removed. He was transferred to the medical ward on January 24th, and his condition was noted as follows :—

The patient is emaciated, anxious and prostrate; the skin dry and

* Read by title at the Canadian Medical Association, Toronto, September 1, 1899.

† Senator, *Deut. Zeit. für Med.* II.

‡ Welch and Flexner, *Journal of Exp. Med.* I.

hot; temperature, $99\frac{1}{5}^{\circ}$ F. a.m., $101\frac{1}{5}^{\circ}$ F. p.m.; respiration labored 40; the breath foul, pulse 110 and readily compressible.

On physical examination there is distinct fulness over the right side of the thorax. The percussion note anteriorly is normal to the fifth rib, but from here to the costal border it is loud and hyper-resonant; the axilla is clear and posteriorly there is dulness at the base, as far as two fingers' breadth. The line of dulness is arched, reaching higher in the middle than at either side. Distant metallic respiration is heard over a small area the size of the palm of the hand in the upper axillary region, and very feeble breath sounds over the dull area posteriorly. Over the remainder of the lung the breath sounds are slightly feeble. A distinct metallic coin sound is elicited over the area of metallic breathing, and also through to the back, and there is distinct succussion. The breath sounds are slightly enfeebled over other portions of the lung.

On the 28th an aspirating needle was introduced in the 8th space posteriorly and twenty ounces of almost pure blood drawn off, which coagulated immediately in the bottle. The physical signs remained much as before but the metallic respiration disappeared. The further progress of the case was progressively downwards. The prostration increased; the temperature continued moderately elevated 100° , 101° , once 102° ; the pulse became rapid and weak, and death took place from exhaustion on February 4th.

Repeated examinations of the rather scanty sputum always failed to show tubercle bacilli.

Abstract of autopsy performed by Dr. Wyatt Johnston:—

Body considerably emaciated.

Dense adhesions between upper surface of the right lobe of the liver and the diaphragm. On pouring water over the pectoral muscles near the axillary line a few bubbles of gas escape on piercing the chest wall.

The right pleura shows some adhesions anteriorly and in the axilla, whilst below it is densely adherent and nearly a quarter of an inch thick. There is a thick-walled sac in the pleura posteriorly containing fetid pus. After removing the organs *en masse*, this cavity is found to communicate by an opening admitting a finger with a space between the right lobe of the liver and the diaphragm, and which contains pus similar to that in the pleura. There is no communication between either cavity and a bronchus, as tested by air and water pressure. There was an acute splenic tumor, but otherwise the abdomen was normal, the appendix and its neighborhood being free from disease. Bacteriological examination showed a mixed culture consisting principally of the bacillus coli with proteus.

The diagnosis during life was that of a localised pneumothorax at the base of the lung. The cause of this was, however, very obscure. There

was no evidence of tuberculosis of the lung, bacilli being constantly absent from the sputum. The possibility of a pyopneumothorax subphrenicus was considered, but against this was the absence of any downward displacement of the liver and, in addition, the heart was displaced to the right, a sign which is said to be commonly absent in collections below the diaphragm.

The conditions actually found were rather peculiar. An old thick firm abscess wall was seen, bounded below by the liver and above by the diaphragm. This cavity had no communication with any of the hollow abdominal viscera, nor was any source of such an abscess discovered in the abdomen. The lung, which had been pushed up, had formed a circular ring of adhesions on its pleural surface to the chest wall, dividing the pleural cavity into an upper and lower chamber. The latter communicated by a perforation in the diaphragm with the sub-diaphragmatic abscess which had hitherto been latent.

That the presence of gas was not due to any communication with any of the hollow abdominal viscera is clearly shown by the anatomical conditions, and the presence of a gas-producing bacillus, the bacillus coli, seems the only explanation of the presence of gas in the pleural sac.

So few cases have hitherto been reported of pneumothorax resulting from gas-producing organisms, that a synopsis of three previous cases may be given.

Levy,* writing in 1895, describes a case in a man aged 48, beginning with cough, pain in the left side and fever. Examination showed a left sided pleurisy. After four aspirations, three months after the onset of the illness, there was evidence of pneumo-thorax. Owing to dyspnoea the operation for empyema was performed, but the patient sank and died.

At the autopsy there was bilateral pleurisy and pericarditis with 1.5 litres of reddish yellow fluid in the right pleura, and in the upper third of the right lung a firm focus, the size of an egg, containing whitish caseous masses. A small yellow nodule was present on the small intestine, and a number on the under surface of the diaphragm. The pleuritic exudate removed during life showed the presence of an anaërobic bacillus, identical with that previously found by Fränkel in gas phlegmons and subcutaneous emphysema and subsequently identified as Welch's bacillus capsulatus aërogenes. The bacillus produced gas both in cultures and in living tissues.

This case seems, then, to have originated as a tubercular (?) pleurisy with effusion, subsequently infected with the bacillus aërogenes.

A. G. Nichols,* of Montreal, has recorded a case which is less open to

* Levy, Ueber den Pnenmothorax ohne Perforation, Arch. für Exp. Pharmakologie, Bd. 35, 335.

* Nicholls, Notes on some cases of infection by the bacillus aërogenes capsulatus, British Medical Journal, 1897, II., p. 1845.

criticism than any that have been published yet, inasmuch as gas developed in the pleural and pericardial cavities.

The patient, a male, æt. 21, was admitted to the Royal Victoria Hospital for severe abdominal pain, beginning six days previously. There was evidence of peritonitis and a diagnosis of perforative appendicitis was made, which was confirmed by operation. A left-sided pleurisy was present on admission, and four days later evidence of pneumonia, and a few days later right pneumothorax and pneumopericardium were distinctly recognised. Septic symptoms were present but there was no sudden pain or collapse as is commonly found in perforative pneumothorax. No communication was present between the abdominal and thoracic cavities, and the case was thus clearly one of gas production in the pleura and pericardium. The autopsy fully confirmed the above conditions, and the *bacillus capsulatus aërogenes* was subsequently discovered in sections stained by Gram-Weigert's method. Anaërobic cultures were not made, as the case occurred previous to Welch's publication.

May and Gebhart.*

A male, æt. 43, stabbed himself twice in the cardiac region, with a dagger which had been previously used on another for a similar purpose. The wounds were apparently trifling, and healed quickly, but the temperature remained elevated and signs of fluid developed in the left pleura, and on aspirating a quantity of cloudy and markedly hæmorrhagic exudate was drawn off. A fortnight after the wound occurred evidence of pneumothorax was distinct. The gas when drawn off lit with a bluish flame.

Pericardial exudation developed; and in spite of incisions into both the pleura and pericardium, the patient died.

The autopsy confirmed the diagnosis, the anatomical diagnosis reading:—Subacute, left-sided, purulent pleurisy and pericarditis, following a stab in the left side.

The *bacillus coli* and *staphylococcus pyogenes* were found in the exudate. Careful analysis of the gas from the pleura showed that it consisted of CO_2 , H, & N, but no O. The presence of a gas (H) not contained in atmospheric air proves clearly the production of gas in the pleural cavity.

In all of these four cases the proof that gas was evolved by bacteria is very conclusive, and it may therefore be accepted that such an event occasionally occurs. That such cases are rare is evident by the very scanty literature on the subject, but like other rare conditions, it may be more frequently found if looked for.

In two cases the *bacillus aërogenes capsulatus* was present, and in two

* May and Gebhart, Ueber Pneumothorax durch Gasbildeads Bakterien, Deut. Arch. für Klin. Med., Bd. 61, p. 323.

the bacillus coli. With our present scanty knowledge on the subject it is difficult to establish satisfactorily any diagnostic points. It will be noticed, however, that in three of the four cases there was abdominal disease, and in the remaining one the origin seems to have been a wound infection. In Nichols' case the evidence of abdominal disease (appendicitis) was distinct during life. In Levy's case there was tuberculosis of the peritoneum, discovered only at the autopsy, and in my own the subdiaphragmatic abscess was doubtless infected by the bacillus coli from the intestine. The frequency with which the abdominal organs are affected by the bacillus capsulatus aërogenes, and the constant presence of the gas-producing bacillus coli in the large intestine, are in accord with the clinical features of three of the recorded cases, and where there is evidence of abdominal disease with subsequent pneumothorax, the possibility of the production of gas by bacteria is worth bearing in mind. The onset of the condition seems commonly to be gradual, and not abrupt, as is usual in pneumothorax.

May lays much stress on a chemical analysis of the gases. He points out that a cavity may become infected by air-producing bacteria, and yet the pneumothorax be due to communication with the external air. The presence of a gas in the cavity, not found in atmospheric air, may therefore be regarded as a proof of its zymotic character.

In May's case hydrogen was present in sufficient quantity to burn, and this simple test, if constantly present, may serve to replace the more elaborate method of chemical analysis. It may be remarked that the bubbles of gas produced by the bacillus capsulatus aërogenes are also inflammable.

In conclusion, it may be now accepted :—(1) That pneumothorax may in exceptional cases result from gas-producing bacteria, and that the bacillus coli or bacillus capsulatus aërogenes may be the organism concerned. (2) That the presence of hydrogen or other gases not found in the atmosphere is conclusive proof of this condition being induced by gas-producing bacteria (May).

